THE OPERATIVE TREATMENT OF CLUB-FOOT.[1]

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EVERY surgeon is acquainted with the difficulties that attend the treatment of many apparently simple cases of congenital club-foot. The resistance offered by the gastrocnemius muscle and the plantar fascia is so readily overcome and so easily discernible that one is often induced to give a favorable prognosis in cases where, if due regard had been given to the mobility in the ankle and tarsus, no such favorable view would have been expressed. It is the record of such failures, both in the mechanical and operative treatment, which has led me to investigate the cases operated upon in the Roosevelt Hospital since 1886. Many good results are undoubtedly obtained by mechanical treatment alone in early life, provided the force necessary to correct the deformity can be sufficiently applied, and the ingenious devices for correcting them seem quite sufficient. Yet there are cases in which the mechanical treatment fails to do its work even in children, or where the time to be expended in the treatment cannot be given, through poverty of the parents, not to mention those cases in adults where no treatment has been applied in early life. It is in just this class of cases that the surgeon is called upon to correct the deformity, and the following twenty-five cases belong to this class.[2] In all club-feet a very important and considerable deformity exists in the talus, which is closely wedged in between the malleoli, and is not controlled directly by the muscles passing over it. Its position is alone maintained by its ligamentous attachments. Its relative position is altered according to the degree of deformity. In simple equinus it is rotated upon its transverse axis. In equino-varus of slight degree it is also rotated upon an antero-posterior axis, so that its under surface points towards the mesial surface of the body. In the equino-varus of still severer type it is rotated upon a vertical axis in addition, so that its head and neck are twisted towards the mesial plane of the body. It is not alone in the talus, however, that deformities are found, for the calcaneus, scaphoid, cuboid and semilunar bones contribute very considerably to the production of this compound deformity.

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[1] Read before the New York Surgical Society, December 13, 1893.

[2] No cases have been used which have not been investigated either by the author or by physicians in their places of residence. During this period, 1886 to 1893, forty-one cases have been treated by operation, but in sixteen no answers were obtained to letters addressed to them. They have, consequently, been discarded.

It is on this account that where club-foot is resistant to mechanical means the operative treatment is to be carried on with discrimination as to the bone or bones most involved in its production, so that the operation selected shall be one which will correct the deformity with the slightest injury to the foot.

In the club-foot of the new-born the talus shows a constant and characteristic deformity. Its *neck* is elongated and obliquely directed inward. In the normal foot a line parallel to the outer border forms with the sagittal axis an angle of 38° in the new-born, and of 10.65° in the adult. In congenital club-foot this angle ranges from 49.6° to 64°, and allows greater inversion and supination of the foot. The *body* of the talus is flattened and narrowed posteriorly, resembling a wedge. Its position is that of plantar flexion, and the ankle-joint resembles an amphiarthrodial rather than a ginglymus joint. The *trochlear surface* stretches nearly to the posterior border of the inferior surface, and is smaller anteriorly than posteriorly. The *articular facet* for the *internal malleolus* is scarcely recognizable. That for the external malleolus is situated more anteriorly. The *head* is directed downward, and forms an angle with the axis of the talus of 65°, in contrast with 45° in the new-born.

The calcaneus is rotated in the same axis beneath the talus. Its *tuberosity* is directed against the fibula. Its *processus anterior* is strikingly enlarged. The superior articular facet is obliquely inclined downward and inward, so that pronation is prevented before the inner border of the foot touches the floor. The *sustentaculum tali*, which prevents supination, is wanting, so that supination may be increased in extent. The *articular surface* for the *cuboid bone* is situated upon the mesial side.

The cuboid bone is quadrilateral rather than triangular in shape, which condition is probably due to the growth of its lateral border where freed from pressure. The *scaphoid bone* lies internally upon the caput tali. Their long axes are parallel rather than at right angles to one another. The leg is often rotated inward and the malleolus of the fibula is found upon a plane anterior to that of the tibia. The internal lateral, the plantar, the calcaneo-fibular and the talo-navicular ligaments are shortened, while those upon the lateral border are increased in length. The muscles are found in their normal position. The only tendon of which the relation is changed is that of the peroneus longus. This is found in a groove upon the outer side and under surface of the calcaneus. When the weight of the body is added to a foot which is already deformed in this manner and the muscles in walking have fully exerted their power, we have produced the deformity existing in the congenital club-foot of the adult and, to a less extent, in the old cases of acquired club-foot. These changes are similar to those in the child, but more marked, and are seen particularly in the new and abnormal facets.

The internal malleolus is less prominent and rounder. A facet is formed between it and the scaphoid or cuneiform bone. The groove for the tibialis posticus tendon is very shallow. The *talus* is long and narrow. Its *trochlear surface* is covered with cartilage only upon its posterior part. The *lateral facets* are unlike. The *fibular facet* is well marked, and is situated near the neck and entirely separated from the trochlear surface. The tibial facet is very small. The *head* of the talus is poorly developed, misshapen, and often shows two facets, of which the external has no cartilage and the internal articulates with the navicular bone and is covered with cartilage. The calcaneus is bent upon its long axis, with the concavity upon the mesial surface. Its *upper articular* surface is flattened towards the inner border and is well developed upon the side. The *processus anterior* is longer, higher and prominent externally. The *tuberosity* is raised and stands immediately behind the fibula. Its superior surface is in contact with the posterior border of the tibial articular surface, so that in severe cases the calcaneus seems a part of the ankle-joint. The articular surface for the cuboid is upon the mesial side. The *navicular bone* is a double wedge, the apices of which are seen upon the inner and inferior surfaces. In many cases it is found beneath the internal malleolus and articulates with it by a facet. The *cuboid bone* is displaced inward to an extent equal to two-thirds of its posterior surface. Its sagittal diameter is increased and its superior surface is more convex and prominent. *The cuneiform bones are altered in position only. The first cunei-*form may articulate with the internal malleolus. None of the bones of the foot are of normal size nor compactness. They are fatty and osteoporotic. In the severe cases of club-foot there is a rotation inward not only of the foot, but as well of the knee and leg.

It is customary to consider a club-foot which is to be subjected to any operative treatment under two heads,—viz., the degree of deformity and the causation.

These two conditions decide whether operation should be performed, as well as the severity and kind of procedure and the benefit likely to be derived.

The *first degree* of deformity is represented by a foot which can be readily placed in the normal position and in which the angle between the foot and the leg is greater than 90°.

The *second degree* is represented by a foot which can be reduced less readily and in which the turning of the foot inward is greater. (Tendon and fascial contraction.)

The *third degree* presents a foot in which there is no possibility of a manual correction and in which all the tissues upon the mesial side are shortened.

These three degrees of deformity may exist as congenital or acquired conditions: the former, a primary deformity in the skeleton of the foot; the latter, one dependent upon paresis or paralysis in the nerves, central or peripheral, or upon inflammatory or traumatic conditions which secondarily lead to the deformities in the bones of the foot.

In detailing the histories time will be saved by describing only their special and marked features in full.

In all cases the Esmarch's bandage has been used and strict antisepsis has been employed. The deeper parts of the wound have been united with catgut, while the skin has been sutured with either silk or catgut, depending largely upon whether the dressing was to be removed in one week to correct some malposition likely to occur or whether the operator was satisfied that the position at the time of operation was perfect.

(*a*) CONGENITAL TALIPES EQUINO-VARUS.

CASE I.—C. P., two and a half years; December 9, 1886. *Family history good. Previous personal history, none of the diseases of childhood.*

History of Present Condition.—Talipes equino-varus (double) of *the third degree. The soles of the feet turn inward, the heel is* raised, and the child walks entirely upon the outer border of the foot. The tendo Achillis is strongly contracted. The astragalus is not prominent anteriorly. The deformity is more marked in the mediotarsal joint than in the astragalus or os calcis.

December 10. Tenotomy of the tendo Achillis.

December 13. Wounds healed; feet held in flexed position; plaster-of-Paris dressing; position of left foot is better than that of the right foot.

December 26. Plaster-of-Paris dressing renewed; better position is secured.

January 10, 1887. Plaster-of-Paris dressing removed; position not satisfactory; equino-varus still present.

January 11. Phelps's operation upon the left foot, with tenotomy of the tendo Achillis; foot placed in as nearly normal position as possible; the equinus is much improved; some varus is still present; plaster-of-Paris dressing.

January 21. Plaster of Paris removed; wounds are aseptic; position is not perfect; plaster of Paris reapplied.

January 31, February 21 Reapplication of plaster-of-Paris dressing; position the same.

February 24. Phelps's operation and tenotomy of tendo Achillis upon the right foot; position of the foot improved, but there is still some varus and equinus.

March 15. New plaster splint; position the same.

April 28. Several plaster-of-Paris splints have been applied to the feet; the position of the feet, however, shows still some varus, and the equinus is not wholly relieved.

May 4. Under ether, Phelps's wrench was used upon both feet; feet are placed in plaster-of-Paris splint; the position is now good; no equinus nor varus is present.

May 28. New plaster splints; when removed varus is present.

June 2. Phelps's wrench is again used; position of feet is almost normal; plaster-of-Paris splint.

August 1. Plaster-of-Paris and water-glass splints have been applied since last operation; patient has been walking since June 30; when the splints are removed the feet are still in a varus position, though the equinus is corrected.

November 11. Since the last account water-glass splints have been used; now shoes and spiral thigh-spring are worn, correcting as much as possible the varus and the turning in of the toes.

December 3. Patient discharged; improved, but with an imperfect result, as the varus was not relieved; flexion of the foot can be carried to a right angle; the os calcis does not show any marked supination.

The account obtained from the parents of this child is not very encouraging. There is still some varus present, though an apparatus for its correction was worn for nearly three years. It is certainly an improvement, though not a complete relief of the deformity. Result imperfect.

CASE II.—B. C., seven years; October 14, 1887. Family history, none obtainable. Personal history, always in good health.

History of Present Condition.—Congenital talipes equino-varus of the right foot of the third degree but of moderate extent; patient walks upon the anterior portion of the foot without difficulty; the foot is supinated and adducted, but principally beyond the mediotarsal joint; there is a marked prominence of the astragalus in front of the external malleolus; the plantar flexion, supination and adduction cannot be overcome by forcible pressure; there is no evidence of deformity in the other tarsal bones; the calf of the leg is one inch less in circumference than that of the other leg.

October 15. Incision over the prominent astragalus and in front of external malleolus; removal of the head, neck and greater part of the astragalus, including the prominent anterior portion; foot easily replaced in good position; plaster-of-Paris dressing.

November 1. Splint removed; wound healed; splint reapplied.

November 6. Very slight equinus remains, varus corrected; plaster splint and referred to Out-patient Department; patient was treated in the Out-patient Department for four months with shoe.

August 7, 1893. No apparatus has been worn since leaving the Out-patient Department; the varus is completely relieved; the equinus has disappeared; steps firmly upon the foot, with good flexion at the ankle-joint; *result perfect.*

CASE III.—S. S., six years; October 27, 1888. Family history not obtainable. Personal history, always in good health.

History of Present Condition.—Congenital talipes equino-varus of both feet and of the second and third degree; the dorsum of each foot is in nearly a straight line with the anterior surface of the leg; in the left foot the weight is borne upon the outer border and dorsum, while the plantar surface looks backward and upward; the deformity seems to involve both the astragalus and the bones forming the medio-tarsal joint in the left foot; the left foot is more deformed than the right, which is of the second degree.

October 31. Left foot: Usual curved incision in front of external malleolus and over the dorsum of the foot; extirpation of the astragalus; this does not completely relieve the supination and adduction; removal of a wedge, including a part of os calcis and cuboid; reduction of the deformity is easy; three-eighths of an inch of external malleolus also removed, as it impinges upon the os calcis when the foot is brought into position; plaster-of-Paris splint.

November 28. Wound healed; reapplication of plaster-of-Paris splint.

December 3. Right foot: Tenotomy of the tendo Achillis; reduction of the deformity imperfect; slight equinus remains; plaster-of-Paris splint.

December 7. Wound healed; plaster-of-Paris splint.

December 16. Slight equinus remains; plaster-of-Paris splint.

December 21. Plaster-of-Paris splints applied; left foot, no equinus, no varus; right foot, slight equinus; patient discharged improved.

September, 1893. Physician's report: Is able to flex the foot to more than a right angle, and bears weight upon the whole foot; no varus; has worn no apparatus upon the left foot. Right foot: Equinus has disappeared; no varus present; upon the right a shoe was worn for two years to overcome the equinus and to prevent any varus. Result: Perfect in both feet; but better in left foot, as there is more flexion at the ankle-joint.

CASE IV.—S. W., twenty-two years; May 27, 1889. Family history not obtained. Personal history, always healthy.

History of Present Condition.—Congenital talipes equino-varus of both feet, and of the third degree; markedly deformed; over the proximal extremity of the metatarsal bone of the fifth toe in both feet a large bursa is present; flexion and extension in the ankle-joint of both feet are imperfect; motion is apparently arrested by the astragalus; plantar fascial contraction is moderate in extent; otherwise the foot is one of marked equino-varus.

June 5. Left foot: Usual incision; removal of astragalus and of a wedge, consisting of a part of the os calcis, cuboid and scaphoid bones; tenotomy of the tendo Achillis; reduction of the deformity good; plaster-of-Paris splint.

June 15, 24, and July 18. Plaster-of-Paris splint; healed.

July 25. Right foot: Usual incision; tenotomy of the tendo Achillis; extirpation of the astragalus and of the malleoli of the tibia and fibula; bursa excised; reduction of the deformity is good; plaster-of-Paris splint.

August 4. Redressed; plaster-of-Paris splint; healed.

August 10, 24. Plaster-of-Paris splint upon both feet removed.

August 28, September 20. On crutches with splints.

October 25. Walking without crutches; the right foot is weaker than the left one, but the position in both is good.

November 20. Discharged.

Patient has been seen at irregular intervals since leaving the hospital.

September 9, 1893. The left foot is the stronger; the right foot is weaker in the ankle-joint; the lateral mobility is too great; the position in both feet remains good; flexion and extension at the ankle-joint are rather good; flexion goes to beyond a right angle, extension to about forty-five degrees; compensation at the mediotarsal joint in the right foot; walks daily about six miles without resting; result may be classed as good.

CASE V.—J. B., twenty-four years; July 20, 1889. Family history not known. Personal history, weak, always anæmic.

History of Present Condition.—Congenital talipes equino-varus of both feet; left foot presents an equino-varus of the third degree, moderate in extent; the varus predominates; the plantar fascia is greatly contracted; the patient walks upon the outer and upper surface of the fifth metatarsal bone. Right foot is in an equino-varus position of the second degree, with the equinus predominating; tendo Achillis and the plantar fascia are firmly contracted; in walking the heel is one inch from the ground.

August 2. Right foot: Fasciotomy and tenotomy of the tendo Achillis. Left foot: fasciotomy and tenotomy of the tendo Achillis; cuneiform osteotomy, including head and neck of the astragalus, parts of the os calcis and cuboid bones; plaster-of-Paris splints.

August 14. Healed; plaster splints.

August 26. Plaster splints; position good in both feet.

September 3. Discharged.

Patient was treated in the Out-patient Department for the right foot for three months.

July, 1893. Result good; no varus in either foot; flexion in ankle-joint to a right angle.

CASE VI.—G. H., eleven years; November 8, 1890. Family history not known. Personal history, always healthy.

History of Present Condition.—Congenital talipes equino-varus of both feet and of the third degree; has been treated with apparatus for seven years, and has had five or six tenotomies; scars in the feet indicate previous fasciotomies and tenotomies of the tendo Achillis and tibialis anticus and posticus tendons; in the right foot the pressure is sustained by the outer margin of the foot; the sole looks inward and backward; the dorsum looks outward; the astragalus presents a marked prominence in front of the external malleolus, and seems to prevent full flexion to a right angle; the plantar fascia is contracted and marked by both longitudinal and transverse grooves. In the left foot the equinus is not marked; the prominence of the astragalus in front of the external malleolus is not so marked as in the right foot; the sole looks inward, the dorsum outward; the plantar fascia presents the same furrows; flexion to a right angle exists; pronation impossible.

November 12. Right foot: Cuneiform osteotomy, consisting of the head of the astragalus, part of the os calcis and cuboid; fasciotomy; position good; plaster-of-Paris splint. Left foot: Cuneiform osteotomy, consisting of the anterior portion of the os calcis; position not very good; plaster-of-Paris splints.

November 24. Wounds healed; plaster-of-Paris splints applied.

December 16. Reapplication of splints; right foot is in good position, except for a very slight varus; left foot is not at all satisfactory; varus is marked.

December 24. Patient allowed to walk with the splints.

January 2, 22, 1891. Reapplication of splints.

January 26. Discharged, to see the effect of the weight upon the left foot.

June 20, 1891. Readmitted to hospital; the condition of the right foot is that of a slight varus; in the left foot the varus is still marked; flexion to a right angle in both feet at the ankle-joint.

July 3. Left foot: Cuneiform osteotomy, consisting of part of the scaphoid, the cuboid, and the os calcis in its anterior portion; replacement of the foot in good position; plaster-of-Paris splint.

July 17. Healed; plaster-of-Paris splints.

July 31. Right foot: Cuneiform osteotomy as in left foot.

August 1. Left foot redressed; plaster-of-Paris splint.

August 16, 23. Right foot redressed; plaster-of-Paris splint.

September 26. Both feet in good position; wears ordinary shoes; discharged.

September 1, 1893. Heard from his physician: Function of the ankle-joint is very good; flexion to a little more than a right angle; extension to about 135°; no splints nor apparatus have been used since leaving the hospital; walks daily four or five miles without pain. The first operations were not extensive enough. This case shows the importance of a sufficient removal to correct completely the deformity at the first operation.

CASE VII.—F. H., seven months; December 24, 1890. Family history not known. Personal history unknown.

History of Present Condition.—Congenital talipes equino-varus of both feet, and of the second degree; the equinus is well marked; supination and adduction are slightly marked.

January 10, 1891. Tenotomy of the tendo Achillis and of the posterior tibial tendons on both feet; reduction of the deformity is easy, but there seems to be some varus remaining.

January 22. Left foot: Healed; plaster-of-Paris splint.

January 25. Right foot: Healed; plaster-of-Paris splint.

February 4, 21. Both feet: Plaster-of-Paris splint.

Left foot has a slight tendency to a varus; right foot is in good position; plaster-of-Paris splints applied; referred to the Out-patient Department on March 2; right foot was treated for eighteen months in Out-patient Department; result in both feet good; patient heard from September, 1893.

CASE VIII.—A. H., thirteen years; February 27, 1891. Family history negative. Personal history, always healthy.

History of Present Condition.—Congenital talipes equino-varus of both feet and of the third degree; the plantar surface of the foot looks inward and backward and the plantar fascia is strongly contracted; the scaphoid is deformed and is bent inward and below the head of the astragalus; the dorsum of the cuboid bone forms a part of the bony support of the foot; the astragalus is normal, so far as its relation with the tibia and fibula is concerned; the three cuneiform and the metatarsal bones are completely inverted, so that the dorsal surface looks externally and their plantar surfaces internally; the metatarsal bones are folded into a roll, so that the first and fifth are close together; flexion and extension at the ankle-joint can be made in slight extent; marked atrophy of the muscles of the leg; the dorsum of the foot is covered with a thick, callous skin and a bursa.

March 7. Right foot: Tenotomy of the tendo Achillis, anterior and posterior tibial tendons; fasciotomy; removal of the bursa; cuneiform osteotomy, including the anterior part of the os calcis, cuboid, and of the head and neck of the astragalus; reduction of deformity not quite perfect; plaster-of-Paris splint.

March 17. Dressed; healed; plaster-of-Paris splint.

March 24. Position not perfect; plaster-of-Paris splint.

April 2. Left foot: Tenotomy of tendo Achillis; fasciotomy; cuneiform osteotomy, including the head and neck of the astragalus, part of the calcaneus, and cuboid and scaphoid bones; reduction; plaster-of-Paris splint.

April 12. Dressed; healed; plaster-of-Paris splint.

April 24. Right and left foot. Plaster-of-Paris splint; position of left foot is good; position of right foot is not perfect.

May 1. Patient is walking about the ward; right foot is not perfect; there is still a varus position; flexion and extension at the ankle are good in both feet, and in this particular the result may be classed as perfect.

June 1. Walks pretty well, but the right foot is still supinated.

July 1. As the ankle-joint is freely movable, a supra-malleolar osteotomy of the tibia and fibula is done and the varus position is corrected; plaster-of-Paris splint.

July 25. Right foot: Position is good; plaster-of-Paris-splint.

August 25, September 15, October 9. Still in wards; walks well.

November 20. Discharged; walks well on the plantar surfaces of both feet, but the right foot still presents some varus and is not so good as the left foot.

September, 1893. Report from the physician: Patient is working daily behind a plough and has little difficulty in earning his living; both feet rest squarely upon the ground, flexion at the ankle to a right angle; result good.

CASE IX.—H. G., fifteen years; November 22, 1892. Family history negative. Personal history, always healthy.

History of Present Condition.—Congenital talipes equino-varus of both feet and of the third degree; supination of the foot is marked; the cuboid bone is covered by a bursa; slight plantar flexion at the ankle-joint; fascial contraction extensive; deformity seems to be mostly in the astragalus, which is extensively deformed; no great deformity in the other bones; both feet present the same degree of deformity.

December 10. Right foot: Fasciotomy; extirpation of the astragalus; replacement is easy; plaster-of-Paris splint.

December 16. Healed; plaster-of-Paris splint.

December 18. Left foot: Fasciotomy; extirpation of the astragalus; replacement easy; plaster-of-Paris splint.

December 27. Left foot: Healed; plaster-of-Paris splint. Right foot: Plaster-of-Paris splint.

January 7, January 26, February 11, 1893. Both feet: Plaster-of-Paris splints.

February 16. Allowed to walk.

February 21, March 16. Plaster-of-Paris splints.

March 29. Plaster-of-Paris splints; discharged.

August, 1893. Position in both feet is good; no tendency to a varus; flexion at the ankle-joint to beyond a right angle; result perfect.

CASE X.—Y. N., three years; September 7, 1892. Family history negative.

History of Present Condition.—Congenital talipes equino-varus of the right foot and of the third degree; the varus is well marked; the equinus is slight; the patient walks upon the outer border of the foot, upon which is a callosity; the deformity is in the medio-tarsal joint.

September 9. Tenotomy of the tendo Achillis; fasciotomy of the plantar fascia; cuneiform osteotomy, including portions of the os calcis and cuboid bones; dressed; plaster-of-Paris splint.

September 12, September 21. Dressed; plaster-of-Paris splint.

October 3. Plaster-of-Paris splint; position is good, slight inversion of the foot.

October 23. Plaster-of-Paris splint; result good, except for inversion, which is slight.

August, 1893. Patient was seen and position is good; no splint has been worn; flexion at the ankle-joint to a right angle; result good.

CASE XI.—H. B., eight years; January 22, 1892. Family history negative. Personal history, always healthy.

History of Present Condition.—Congenital talipes equino-varus of both feet and of the third degree. Right foot: Sole of foot looks inward and upward; point of pressure over the external surface of the displaced astragalus and os calcis. Left foot: Sole looks inward and backward; point of greatest pressure, os calcis anterior extremity; the right foot is more markedly deformed than the left; motion at the ankle-joint is good; flexion to a right angle; extension in small amount.

February 12. Right foot: Tenotomy of tendo Achillis; excision of bursa over os calcis and astragalus; cuneiform osteotomy, including the head of astragalus, a portion of the os calcis, the cuboid, a portion of the scaphoid; dressing; plaster-of-Paris splint.

February 15. Healed; plaster-of-Paris splint.

March 2. Left foot: Same operation, but smaller in extent.

April 18. Healed; plaster splints to both feet.

April 30. Plaster-of-Paris splints removed; left foot in good position; the right foot in slight varus; discharged; treated in Out-patient Department, with brace for right foot, for six months.

October, 1893. Left foot: Flexion at ankle is good; no varus. Right foot: Flexion at ankle is good; the ankle-joint is a little loose; the varus, when walking, exists in very slight degree; result good.

CASE XII.—I. K., seven years; January 7, 1892. Family history negative. Personal history, always healthy.

History of Present Condition.—Congenital talipes equino-varus of both feet and of the third degree; the equinus is slightly marked; supination is marked; the sole looks backward and upward; point of pressure is the extremity of the os calcis, which is covered by a bursa; patient also presents a cleft palate.

January 9. Right foot: Excision of bursa; cuneiform osteotomy, including head of the astragalus, portion of os calcis, and the scaphoid and the cuboid; tenotomy of tendo Achillis and fasciotomy; replacement of the foot is easy; plaster-of-Paris splint.

January 15. Plaster-of-Paris splint; position of foot is good.

February 4. Left foot: Same operation.

February 8. Plaster-of-Paris splint applied; position is good in both feet.

March 16. Operation upon the cleft palate.

March 23. Died.

The immediate result upon this case was a good one. The examination of the feet after death showed a perfect fitting of the sides of the wedge and no infection. Death was due to the operation upon the cleft palate, and in no way was connected with operation upon the feet.

CASE XIII.—J. A., thirteen years; May 31, 1893. Family history negative. Personal history, always in good health.

History of Present Trouble.—Congenital talipes equino-varus of both feet and of the third degree; had previous treatment with apparatus for three years; both equinus and varus are very marked; no movement at the ankle-joint; right foot: astragalus is prominent in front of external malleolus; the movement of flexion is not perfect; the greatest deformity seems to be in supination of the os calcis and at the medio-tarsal joint.

June 2, 1893. Tenotomy of tendo Achillis; fasciotomy, cuneiform osteotomy, including head of the astragalus, part of os calcis, scaphoid and cuboid bones; replacement easy; plaster-of-Paris splint.

June 17. Healed; plaster-of-Paris splint.

June 26. Similar operation upon the left foot, which presents exactly the same deformity in the bones.

June 29. Right foot: Plaster splint.

July 14. Left foot: Healed; plaster splint.

July 26. Both feet: Plaster splints.

August 18. Allowed to walk in the splints; the left foot is not so good as the right; the os calcis is still supinated to some extent.

August 28. Referred to Out-patient Department for apparatus; patient could not obtain the apparatus, and in consequence an increase in the deformity of left foot; the right foot is not correct, as the flexion at the ankle-joint is not quite that of a right angle.

November 4. Readmitted to the hospital; the right foot presents a satisfactory result, but not a good one, as the leg cannot be brought forward to a right angle with the foot, though the deformity in the foot is corrected; in the left foot the same trouble exists, together with an unrelieved supination of the os calcis. Extirpation of the astragalus and half an inch of external malleolus in both feet; plaster-of-Paris splints.

CASE XIV.—J. L., five years; July 3, 1893. Family history negative. Personal history, always healthy.

History of Present Condition.—Congenital talipes equino-varus of the right foot; sole looks inward; supination is marked; the equinus is also marked; the upper half of the tibia is curved, with the convexity backward; the lower half is unusually small; the external malleolus is prominent and bears some of the weight of the body; a bursa covers it; there is considerable mobility in the tibio-fibular articulation (inferior); the leg is two inches shorter than the other leg; it is so rotated that the toes point to the heel of the other foot.

July 11. Fasciotomy; extirpation of the astragalus and external malleolus; replacement; plaster-of-Paris splint.

July 25. Healed; plaster-of-Paris splint.

August 8. Plaster-of-Paris splint.

August 17. Allowed to walk; the foot rests squarely upon the floor, but, owing to the rotation inward of the extremity, it is at a right angle to the sagittal axis of the body.

August 25. Osteotomy of the femur three inches above the condyle; rotation inward corrected; plaster-of-Paris splint.

September 17. Plaster-of-Paris splint.

October 9. Posterior half of the foot is in good position; slight adduction and supination in the anterior half; a shoe to correct or prevent the increase of this deformity is used; result is satisfactory at present and promises to be good (December, 1893).

CASE XV.—J. W., four years; July 12, 1893. Family history negative. Personal history, healthy. Congenital deformities in both hands and one foot; the foot has been treated with apparatus for three years.

History of the Present Condition.—Congenital talipes equino-varus of the left foot; the treatment with apparatus has overcome the equinus; the varus, however, still remains.

July 15. Cuneiform osteotomy including head of astragalus and parts of os calcis and cuboid bones; plaster-of-Paris splints.

July 31. Healed; plaster-of-Paris splints.

August 28. Splints removed; no varus nor rotation inward of foot; result perfect.

December 13. No varus present; motion at ankle good; no apparatus used.

TABULATED SUMMARY.

VARIETY, AND DEGREE, AND DATE.	AGE.	RESULT.	WHEN SEEN AFTER OPERATION, OR HEARD FROM.	METHOD OF OPERATION.
1. Talipes equinovarus, double; third degree; December 9, 1886.	2½ yrs.	Imperfect in both.	August 7, 1893.	Tenotomy of tendo Achillis; Phelps's operation; wrench (1 and 2).
2. Talipes equinovarus, single; third degree; October 4, 1887.	7 yrs.	Perfect.	August 9, 1893.	Removal of the head, neck and part of body of the astragalus.
3. Talipes equinovarus, double; second and third degree; October 27, 1888.	6 yrs.	Perfect in both.	September 9, 1893.	Extirpation of astragalus, and cuneiform osteotomy of part of os calcis and cuboid (1); tenotomy of tendo Achillis and apparatus for two years.
4. Talipes equinovarus, double; third degree; May 27, 1889.	22 yrs.	Perfect.	December 13, 1893.	Extirpation of astragalus and part of os calcis, scaphoid and cuboid as a wedge; tenotomy of tendo Achillis (1); one-half inch of the malleoli and entire astragalus; tenotomy of tendo Achillis (2).
5. Talipes equinovarus, double; second and third degree; July 20, 1889.	24 yrs.	Good.	July, 1893.	Fasciotomy and tenotomy of tendo Achillis (1); fasciotomy, tenotomy of tendo Achillis, wedge including neck of astragalus, part of os calcis and cuboid (2).
6. Talipes equinovarus, double; third degree; November 8, 1890.	11 yrs.	Good.	November, 1893.	Fasciotomy; wedge, including part of astragalus, os calcis and cuboid (1); wedge including anterior part of os calcis (2); wedge including more of astragalus, os calcis and cuboid (1); wedge including scaphoid and cuboid (2).
7. Talipes equinovarus, double; second degree; December 4, 1890.	7 mos.	Good.	September, 1893.	Tenotomy of tendo Achillis and posterior tibials (1 and 2), and apparatus for one year.
8. Talipes equinovarus, double; third degree; February 27, 1891.	13 yrs.	Good.	September, 1893.	Wedge including head and neck of astragalus, part of os calcis and cuboid; tenotomy of tendo Achillis; fasciotomy (1) wedge including head and neck of the astragalus, part of os calcis, cuboid and scaphoid; tenotomy of tendo Achillis (2).
9. Talipes equinovarus, double; third degree; November 22, 1892.	15 mos.	Perfect.	August, 1893.	Fasciotomy; extirpation of astragalus (1 and 2).
10. Talipes equinovarus, single; third degree; September 7, 1892.	3 yrs.	Good.	August, 1893.	Tenotomy of tendo Achillis; fasciotomy; cuneiform osteotomy of os calcis and cuboid.

Variety, and Degree, and Date.	Age.	Result.	When Seen After Operation, or Heard From.	Method of Operation.
11. Talipes equinovarus, double; third degree; January 22, 1892.	8 yrs.	(1) Perfect. (2) Good.	October, 1893.	Tenotomy of tendo Achillis; wedge, including head of the astragalus, part of os calcis, cuboid and scaphoid (1); same operation, but smaller in extent (2).
12. Talipes equinovarus, double; third degree; January 7, 1892.	7 yrs.	Good at 2½ mos.	March 22, 1892.	Wedge, including part of astragalus, part of os calcis, one-half cuboid and scaphoid; tenotomy of tendo Achillis; fasciotomy (1 and 2).
13. Talipes equinovarus, double; third degree; May 31, 1893.	13 yrs.	. . .	December 13, 1893.	Wedge, part of astragalus, os calcis, cuboid and scaphoid; tenotomy of tendo Achillis and fasciotomy (1 and 2); extirpation of the astragalus and malleolus (one-half inch) of fibula (1 and 2).
14. Talipes equinovarus, single; third degree; July 3, 1893.	5 yrs.	Satisfactory at present. Good in time.	December 13, 1893.	Fasciotomy; extirpation of the astragalus and external malleolus (one-half inch); femoral osteotomy.
15. Talipes equinovarus, single; third degree; August 10, 1893.	4 yrs.	Perfect.	December, 1893.	Wedge, including parts of os calcis and cuboid.

These fifteen cases represent the severer forms of congenital club-foot, in which twenty-six feet have been operated upon for deformity of the second and third degree, with perfect results in nine feet, good results in fourteen feet, satisfactory result in one foot, and imperfect result in two feet.

A perfect result is one in which the patient walks squarely upon the sole of the foot and with flexion enough at the ankle-joint to make a perfect step.

A good result is one in which the patient steps squarely upon the foot, but is unable to flex the ankle sufficiently to bring the leg forward of a perpendicular to the floor without raising the heel.

A satisfactory result is one in which the *bared foot* shows that the outer edge of the sole bears the greater part of the weight, owing to a twist in the foot.

An imperfect result is one in which the correction of the equinus or varus has not been produced.

The operations may be classed under two heads:

(1) Those upon the soft parts.

(2) Those upon the bones.

Of the former we have four cases with six feet operated upon by tenotomies and fasciotomies alone with one perfect result, three good results, and two imperfect results. The imperfect results may be excluded from this division as being an imperfect application of the operation (Phelps's).

The bone operations we include under three heads:

(1) The extirpation of the astragalus, partial or complete, with or without the external malleolus.

Of these there are four cases with five feet; one of the head, neck and part of the body of the astragalus, really a wedge, with a perfect result; four cases (three patients) of complete extirpation of the astragalus alone, in which we have three perfect results and one good result.

(2) The cuneiform osteotomies, including parts of the astragalus, os calcis, cuboid, scaphoid and cuneiform bones, with or without tenotomies and fasciotomies, comprise twelve cases (seven patients) with two perfect results and ten good results.

(3) The extirpations of the astragalus and cuneiform osteotomies comprise four cases, in three patients, with four perfect results.

As to the treatment of congenital club-foot, there can be no doubt that the very best results are obtained by mechanical treatment during the first thirty months of life, during which time the growth of the foot is relatively the greatest. Mechanical treatment, combined with fasciotomies and tenotomies during this period, in the first and second degrees of deformity, give results which in after life show no imperfections in motion nor atrophy of the foot, as may at times be seen after operative interfer ence. The surgeon, however, does not come in contact with these cases. He only sees them when the skeletal deformity is marked, and the motions in the ankle and tarsus are limited, and he is to obtain the best result he can from a poorly-constructed and deformed foot.

Tenotomies and fasciotomies, combined with mechanical treatment, are to be used in all cases of the second degree, where tendon and fascial contraction cause in great part the deformity, and where after these performances the unfolding of the foot is possible. As an adjunct to the bone operations, tenotomies and fasciotomies are of the greatest service. When, however, the unfolding of the foot puts the skin and deeper tissues on tension, some method of operation which will relieve this tension, when the foot is pronated, abducted and flexed, must be employed. The selection must be made of an operation in which, when the correction is secured, and the union of the tissues has taken place, no apparatus is necessary to hold it in position. Of these bone operations the extirpation of the astragalus would seem to be indicated where the chief deformity in the foot is due to the astragalus, and the flexion at the ankle-joint cannot be carried beyond a right angle with the foot, on account of the prominence of this bone anteriorly. The advantages of this method as contrasted with the removal of a wedge from the tarsus are that the arch of the foot remains intact, and the loss of the keystone of this arch (the astragalus) does not weaken it, since the softened bones, owing to the weight of the body in walking, take a nearly normal position. The growth of the foot is not interfered with in any essential degree. The supinated position of the calcaneus is corrected, and it gives in place of a very slightly movable ankle-joint, a syndesmosis, which is often more movable, and, provided the deformity has been corrected, gives no greater tendency to recurrence.

The excision of the astragalus alone is only to be selected (excluding the operation in the child in early life), when it removes completely the deformity by relieving the plantar flexion at the ankle, and by allowing the correction of the angular bend and torsion at Chopart's joint.

This necessarily provides that no great degree of nearthrosis exists between the calcaneus, the tibia and the fibula, producing plantar flexion, and that the deformity at the medio-tarsal joint is slight.

In the adult, where the difficulty in removing the astragalus is often considerable, the removal of a portion of the malleolus externus facilitates the operation, and is not followed by any untoward results. In the child, however, such a removal is not admissible, for fear of the unequal growth and deformity which may result.

When the flexion at the ankle-joint can be brought to a right angle or more, and the distortion of the foot is principally in the medio-tarsal joint, cuneiform osteotomy is the slightest and easiest method of treatment. In the child the correction is often completed by the removal of a wedge, involving the adjoining parts of the cuboid and calcaneus, though it is *not often* necessary, and *only* admissible when mechanical treatment has failed. I have so far seen no interference in growth from such limited wedges. In the adult the bone removed is more quadrilateral than triangular in shape, and with its broad surface upon the dorsum and lateral border of the foot.

To correct this deformity the scaphoid, head of the astragalus, part of the calcaneus and cuboid bones are most frequently removed. Just so much is to be removed as will correct the torsion, angles and curves of the foot. The principal disadvantages of this method seem to be that the supination in the calcaneus remains, that the arch of the foot is broken, and that the growth of the foot is interfered with in the younger class of cases. Moreover, the synostosis which takes place at the line of resection, provided the motion at the metatarso-phalangeal articulation is not sufficient, will force the patient to walk largely upon the outer half of the foot.

The indications for this method are, if we exclude age: (*a*) Motion at the talo-crural articulation to a right angle or more with considerable ease; (*b*) no great lateral mobility at the ankle; (*c*) slight supination in the calcaneus and motion in the metatarso-phalangeal joints. While, on account of the synostosis at the line of resection, the motions of the foot cannot be compared with those of a normal foot, very favorable results are obtained, and where failures exist they seem to be due to an uncorrected supination of the calcaneus, excessive lateral motion at the ankle-joint and the want of motion in the metatarso-phalangeal joint. In the severest forms where the deformity consists in a nearthrosis between the supinated calcaneus, the tibia and the fibula with a prominent astragalus and no flexion at the ankle-joint together with excessive distortion at Chopart's joint, the talus extirpation is combined with cuneiform osteotomy. It is, indeed, impossible without a talus extirpation to correct the plantar flexion at the ankle-joint and the supination of the calcaneus. Having corrected this, it is necessary to flex dorsally, pronate and abduct the forefoot, and to do this we must remove a sufficient wedge from the medio-tarsal-joint. Happily, these severe forms requiring, in addition to the extirpation of the astragalus, the cuneiform osteotomy are rarely found, except in adults. When these exist in children, such cuneiform resections should not be performed before two and a half years, at which time the children have begun to walk. Such an osteotomy never involves more than a part of the processes anterior of the calcaneus and a part of the cuboid bone. The result depends more upon the extirpation of the astragalus and the separation of the calcaneus from the fibula (ligamentum calcaneo-fibulare) than upon the removal of the wedge at the medio-tarsal joint, for unless the supination of the calcaneus is corrected, and dorsal flexion at the ankle-joint is produced, a cause for an early recurrence is left in the equinus and supination of the calcaneus. While an equinus remains the foot in the last act of stepping is always adducted and twisted upon its long axis, a motion or motions which easily result in the production of a varus, especially when the calcaneus remains supinated. To thoroughly correct this tendency, a dorsal flexion beyond a right angle is necessary, and to correct this the talus is sacrificed.

(*b*) CONGENITAL TALIPES EQUINO-VALGUS.

CASE I.—M. A., eleven years; January 24, 1890. Family history, negative. Previous personal history, healthy.

Present Condition.—Congenital talipes equino-valgus of the left foot; the inner margin of the astragalus rests upon the ground; the foot is in equino-valgus position and cannot be flexed to a right angle; it is of the third degree.

January 31. Tenotomy of the tendo Achillis; partial arthrodesis of the ankle-joint involving the inner half of the astragalus and articular surface of the tibia, in form of a wedge, and cuneiform osteotomy of the astragalus and scaphoid bones; plaster-of-Paris splints.

February 10. Wounds healed; position good; plaster-of-Paris splint.

February 18, February 27. Plaster-of-Paris splint.

March 14. Plaster-of-Paris splint; discharged with apparatus to prevent recurrence.

August, 1893. Report from the physician in attendance is that an apparatus was worn for six months; flexion exists at the ankle-joint to a right angle; the inner border of the foot shows no falling; the heel and toes are the points of pressure in the foot; no valgus is present; result is good.

Variety, and Degree, and Date.	Age.	Result.	When Seen or Heard From.	Method of Operation.
Talipes equino-valgus; third degree; single; January 24, 1890.	11 yrs.	Good.	August 10, 1893.	Tenotomy of tendo Achillis; arthrodesis of ankle-joint with removal of wedge from articular surface of astragalus and tibia, cuneiform osteotomy of part of astragalus and scaphoid bones.

The changes in the bones of the foot in all forms of valgus are slight, and seem both in the congenital and acquired variety to be largely influenced by the pronated position of the calcaneus, and the pressure upon the ligamentum calcaneo-naviculare by the talus.

The caput tali is always prominent, owing to the lateral displacement and rotation of the navicular bone. Its superior articular surface is flattened rather than rounded. The facets for the malleoli are placed anteriorly to their normal position. The more marked the valgus the more the navicular facet of the talus is displaced upward and outward, and the facet for the ligament (calcaneo-navicular) occupies the inner and lower portion of the head. In the severest types the ligament facet occupies the whole articular surface of the head, with the exception of a small portion of the upper and outer part.

The calcaneus suffers changes only upon its surfaces.

The navicular bone is often much altered in shape, so that the bone is represented by a wedge, the base of which is directed towards the sole. It is also rotated upon an antero-posterior axis. The cuboid and semilunar bones are not altered, especially in shape, but show the same rotation.

The positions of the joints in congenital flat-foot are in the talo-tarsal joint, pronation as well as a sliding of the talus inward and forward upon the calcaneus; in the calcaneo-cuboid joint, a position of reflexion ; in the talo-crural joint, a plantar flexion, which is looked upon as a compensatory movement. It is a direct result of the falling of the external arch. As a result the flat-foot becomes an abducted, pronated and reflexed foot, with adduction at Lisfranc's articulation in the severest cases. In the case we have at hand the operation was devised to remedy this deformity.

(1) To relieve the equinus by tenotomy of the tendo Achillis.

(2) To change the pronated position of the calcaneus and talus by removing a sufficient wedge from its superior surface, and producing ankylosis between it and the tibia.

(3) To produce a proper internal arch by removing a sufficient wedge, involving both the displaced head of the talus and the scaphoid.

This is essentially a combination of Ogston's and Burnet's operations, with this difference, that the ankle-joint is opened and ankylosis is obtained. Whether a better result would have been obtained had the wedge removed not involved the ankle-joint is a matter of experience.

(*c*) ACQUIRED CLUB-FOOT.

Paralytic Variety.—Of this variety we have nine cases of talipes equino-varus, and one case of talipes calcaneo-cavus.

CASE I.—N. L., sixteen years ; February 9, 1887. Family history, negative. Previous personal history, healthy ; at five years infantile paralysis.

History of Present Condition.—At five years of age infantile paralysis, involving the right foot, and resulting in eight weeks in a talipes equino-varus; apparatus was worn for four years; at present the equinus and varus are marked; the long axis of the foot is shortened, and the foot at the medio-tarsal joint is in plantar flexion and supination; the deformity is of the third degree.

February 10. Tenotomy of the tendo Achillis; excision of the head and neck of the astragalus and part of os calcis in form of wedge; dressing; plaster-of-Paris splint.

March 11. Dressing removed; healed; position good; plaster-of-Paris splint.

March 21. Plaster-of-Paris splint.

March 31 to April 9. About wards with apparatus.

April 9. Discharged. Result is good so far as position is concerned; wears apparatus to flex the foot upon leg.

August 9; 1893. Account from patient is that the brace was worn for one year; the foot is still in good position; there has been no tendency to recurrence; flexion at the ankle to a right angle with the leg is impossible unless produced by mechanical contrivances attached to shoe, though he walks well without an apparatus.

Case II.—E. D., fourteen years; March 15, 1889. Family history, negative. Previous personal history, moderate anæmia.

History of Present Condition.—At two years she had convulsions, followed by hemiplegia. The deformity in the foot gradually increased, until three years ago, when it became necessary to wear an apparatus; there is still a partial paralysis of the left arm and leg; the left foot is a talipes equino-varus of the second degree, with much contraction in the plantar fascia.

March 20. Tenotomy of the tendo Achillis, and peroneus longus and brevis; fasciotomy of the plantar fascia; replacement easy; dressing, plaster splint.

April 7. Wounds healed; plaster-of-Paris splint.

April 16. Plaster-of-Paris splint.

April 19. Discharged; foot is in good position.

September 10, 1893. Account from patient is that the foot still remains in good position; no power over flexion at the ankle-joint, so that an apparatus is still worn in the shoe, producing permanent flexion. Result is satisfactory.

Case III.—E. B., eleven years; January 5, 1890. Family history, negative. Previous personal history, strong and healthy. At two years of age infantile paralysis, involving lower extremities; has never walked until three years ago, when arthrodesis of right knee was performed at the Roosevelt Hospital; it is still in good position and ankylosed; for the last three years she has been walking with crutches, and the deformity in the right foot has become apparent and increased.

History of Present Condition.—There is a marked talipes equinovarus of the right foot; the left foot is in the position of calcaneocavus; the right foot is in plantar flexion, adduction and well-marked supination; the astragalus is very prominent in front of the external malleolus; calcaneus is supinated slightly; greatest deformity seems to be in the medio-tarsal joint; the left foot shows great eversion when she rests upon it; the point of pressure is the inner and posterior border of the heel; the ankle-joint has a great deal of lateral motion.

January 9. Right foot: Cuneiform osteotomy involving prominent head and neck of the astragalus and part of os calcis; position is good; dressing, plaster-of-Paris splint.

February 2, February 21, March 16, March 30, April 21. Position is good; plaster-of-Paris splints.

May 10. Left foot: Fasciotomy and Karewski's operation, removal of a section, in form of a wedge, from tibia, fibula and astragalus, preserving the anatomical relation and shape of the bones to secure a firm ankylosis; dressing, plaster-of-Paris splints.

May 28. Plaster-of-Paris splints.

June 10. Healed; plaster-of-Paris splints; right foot has no dressing; position is good; left foot is completely healed; plaster splint.

July 24. Has been using both feet aided by apparatus to the foot and crutches for support; discharged. Patient was treated in the Out-patient Department for several months, during which time she gradually became more proficient in the use of the limbs, using, finally, one crutch and no apparatus to the feet.

September 16, 1893. Patient was seen on the above date. She uses a crutch or cane; requires no apparatus for the feet; she walks well as she has an ankylosis in both ankle-joints and the knee; the ankylosis in the right ankle-joint was probably due largely to the opening of this joint during the removal of the portion of the astragalus forming the wedge; it was a fortunate rather than an intended result; the ankylosis is not complete and some motion with stability in joint is present.

CASE IV.—J. H., twenty-five years; April 23, 1890. Family history, negative. Previous personal history, usual diseases of childhood; at two years of age infantile paralysis involving the anterior tibial group of left leg; nine years ago tenotomy of the tendo Achillis, neglected the use of apparatus, deformity has recurred.

Present Condition.—Talipes equino-varus of third degree; the varus is not marked, slight supination and adduction of the fore-foot; supination in calcaneus is very slight; the astragalus is prominent anteriorly and interferes with flexion to a right angle.

April 24. Tenotomy of the tendo Achillis; reduction of the deformity incomplete in that the foot is only held in right-angle position to the leg with some force; the varus is only relieved by force, no further operative treatment; dressing, plaster-of-Paris splint.

May 2. Plaster-of-Paris splint; the position is good, but will require an apparatus to maintain position of flexion and pronation of the foot; wound is healed.

May 6. Discharged; treated in Out-patient Department with apparatus to relieve the tendency to equinus and supination.

August, 1893. The patient still wears an apparatus; it is necessary to continue this at the present as the equinus and varus increase when it is not in use; result from operation is imperfect.

CASE V.—J. T., thirteen years; May 27, 1890. Family history, tuberculosis. Previous personal history, malaria, rheumatism, otherwise healthy.

History of Present Condition.—At three years, infantile paralysis involving the anterior tibial group of right leg; one month after this attack a gradual eversion of the foot followed; two years ago equinus was added to the valgus. At present the position is one of marked equinus with very slight valgus.

May 29. Tenotomy of the tendo Achillis; reduction of the deformity requires some force; plaster-of-Paris splint applied with the foot strongly flexed and inverted.

June 12. Wound healed; foot in good position, though it requires force to retain it; plaster-of-Paris splint.

June 15. Plaster-of-Paris splint; discharged.

September, 1893. Patient has worn an apparatus since; no equinus nor valgus when using splint, without it there is still a tendency to both; result good when apparatus is worn.

CASE VI.—W. R., seventeen years; June 8, 1890. Family history, tuberculosis. Previous personal history, healthy.

History of Present Condition.—At five years of age, infantile paralysis of right leg, leaving his foot in the position of equino-varus of third degree ; the equinus was extreme, the varus well marked, as he describes his deformity ; he has worn a brace until six years ago, when he was operated upon ; evidently a tenotomy of various tendons ; he derived no benefit from this operation ; at present the equinus is well marked ; the dorsum of the foot is much arched ; there is a considerable prominence of bone (astragalus) in front of the external malleolus ; there is some supination of the foot in front of the medio-tarsal joint ; the point of pressure in walking is upon the base of the foot ; there is a well-marked cavus ; the tibia is one inch shorter than that of the opposite extremity.

June 13. Fasciotomy of plantar fascia ; tenotomy of the tendo Achillis ; cuneiform osteotomy, involving head and neck of the astragalus, scaphoid, cuboid and base of fifth metatarsal bone ; dressing, plaster-of-Paris splint ; position is good.

June 14. Healed ; plaster-of-Paris splint.

July 1 and 20. Plaster-of-Paris splint.

Discharged ; patient returned to the hospital until September 1, at which time union was firm.

September, 1893. Patient was examined by me, and the result was good ; flexion can be carried to beyond a right angle, but not voluntarily ; there is no varus present ; patient walks firmly and squarely upon the sole of the foot ; there has been no tendency to a recurrence of the equinus.

CASE VII.—W. W., three and a half years ; November 30, 1891. Family history, negative. Previous personal history, healthy. Parents have noticed during the last year that the foot has gradually become deformed ; no history of a distinct attack of infantile paralysis involving the leg ; the loss of power has been gradual.

Present Condition.—The left foot is in the position of a marked talipes equino-varus ; it is of the third degree ; heel raised ; supination and adduction of fore-foot ; calcaneus slightly supinated.

December 5. Tenotomy ; cuneiform osteotomy, including the head of astragalus, part of os calcis and part of cuboid bones ; reduction easy ; dressing, plaster-of-Paris splint.

December 27. Healed ; position is good ; plaster splint.

January 24. Plaster splint.

February 13. Allowed up with plaster splint.

February 27. Splint removed ; union firm ; patient walks well with slight power for flexion.

September, 1893. Patient has continued to walk without an apparatus; no deformity has recurred; has still some power for flexion; cannot flex voluntarily to a right angle with the leg, though this is easily done by pressure in walking. Result good.

CASE VIII.—H. W., thirteen; July 9, 1892. Family history, negative. Previous personal history, healthy. Eleven years ago infantile paralysis involving the left leg; the muscles recovered their power except anterior tibial group.

Present Condition.—Marked talipes equino-varus; the toes are in dorsal flexion; the deformity seems dependent upon the astragalus more than upon the other bones; it is of the third degree; there is considerable atrophy of the muscles of the leg.

July 16. Fasciotomy; partial extirpation of the astragalus in form of wedge; dressing, plaster-of-Paris splint.

August 4. Allowed on crutches; plaster-of-Paris splint.

August 13. Wound healed; plaster-of-Paris splint.

August 31. Plaster-of-Paris splint.

September 14. Ankylosis not firm; plaster-of-Paris splint; discharged with foot in good position.

September, 1893. Patient was heard from by letter; walks with the foot squarely upon the ground; ankylosis at ankle-joint firm; has never used an apparatus; result is good.

CASE IX.—C. W., seven years; August 24, 1892. Family history, negative.

History of Present Condition.—At the age of two years infantile paralysis involving both legs; recovery followed except in anterior tibials and peroneals of the right leg; he has a well-marked talipes equino-varus of the third degree.

August 30. Tenotomy of tendo Achillis; fasciotomy; cuneiform osteotomy of head of astragalus and os calcis in part; dressing, plaster-of-Paris splint; position is good.

September 3. Plaster-of-Paris splint.

September 21. Plaster-of-Paris splint; healed.

October 9. Plaster-of-Paris splint; good firm union.

October 13. Plaster-of-Paris splint; discharged.

September, 1893. Walks squarely upon foot; no equinus nor varus; foot can be flexed to right angle with the leg; has some power in this movement of flexion, though not quite to a right angle; the ankle-joint has some though slight lateral motion; result is good.

Table of Cases of Acquired Club-Foot. Talipes Paralytica.

1. Talipes equinovarus; third degree; February 9, 1887.	16 yrs.	Good.	August, 1893.	Tenotomy of tendo Achillis; cuneiform osteotomy of head and neck of astragalus, and part of os calcis.
2. Talipes equinovarus; second degree; March 15, 1889.	14 yrs.	Satisfactory.	September, 1893.	Tenotomy of the tendo Achillis; peroneus longus and brevis; fasciotomy.
3. Talipes equinovarus; third degree; and talipes calcaneocavus.	11 yrs.	Good.	September, 1893.	(1) Cuneiform osteotomy, involving head and neck of astragalus, and part of os calcis; (2) fasciotomy and cuneiform osteotomy, involving ankle-joint.
4. Talipes equinovarus: third degree; April 24, 1890.	25 yrs.	Imperfect.	August, 1893.	Tenotomy of tendo Achillis.
5. Talipes equinovarus; third degree; May 27, 1890.	13 yrs.	Satisfactory.	September, 1893.	Tenotomy of tendo Achillis.
6. Talipes equinovarus; third degree; June 8, 1890.	17 yrs.	Good.	September, 1893.	Fasciotomy; tenotomy of tendo Achillis; cuneiform osteotomy of head and neck of astragalus, scaphoid, cuboid, and (5) metatarsal bone.
7. Talipes equinovarus; third degree; November 30, 1891.	3½ yrs.	Good.	September, 1893.	Tenotomy of tendo Achillis; cuneiform osteotomy of head of astragalus, part of calcaneus, and part of cuboid.
8. Talipes equinovarus; third degree; July 9, 1892.	13 yrs.	Good.	September, 1893.	Fasciotomy; partial extirpation of the astragalus in form of wedge.
9. Talipes equinovarus; third degree; August 24, 1892.	7 yrs.	Good.	September, 1893.	Fasciotomy; tenotomy of tendo Achillis; cuneiform osteotomy of the head of the astragalus, and part of the os calcis.

This table represents nine cases of paralytic talipes equinovarus of the second and third degrees, with nine feet operated upon, in which the results are good in six feet, satisfactory in two feet, and imperfect in one foot.

I claim as a good result such a foot as presents no deformity in the tarsus nor ankle-joint, and one in which the muscular power after the operation is sufficient to flex the foot to at least a right angle with the leg, or in which on account of the previous complete loss of power in the leg arthrodesis at the ankle-joint has placed the foot in a good position for use at right angle with the leg.

A satisfactory result is one in which the deformity is completely relieved, but an apparatus must be permanently worn to flex the ankle-joint. An imperfect result is one in which the deformity is not completely relieved, and an apparatus is necessary to maintain the foot in good position.

The tenotomies and fasciotomies comprise three cases, one of the second degree, with a satisfactory result, two of the third degree, with one imperfect result, and one satisfactory result.

There are six cases in which tenotomy, fasciotomy, and a bone operation were done; one of these was a partial cuneiform extirpation of the astragalus with a good result, as the shortening of foot was easily corrected by a thick sole. Five of them were cases in which, besides tenotomies and fasciotomies, cuneiform osteotomy was performed, involving the head of the astragalus, part of os calcis, etc., with five good results.

There remains one case of talipes calcaneo-cavus, in which fasciotomy and cuneiform osteotomy, involving the astragalus and tibia and fibula by means of Karewski's incision, was performed with the idea of producing a complete ankylosis at the ankle, and the relief of the cavus, since the muscular power was completely lost. The result in this case was good.

In the paralytic variety much will depend upon the degree of paralysis in the leg. Where some power remains tenotomy and fasciotomy may be sufficient, or if the deformity exists in the medio-tarsal joint, combined with cuneiform osteotomy. If such power in the muscles is wanting it may be a question whether we do an operation which will permanently fix the ankle-joint in the most useful position, or leave the ankle-joint movable, and rely upon an apparatus which flexes the foot, but allows the extensors of the leg to act.

For my part, I prefer the foot which is permanently fixed at the ankle to one which is movable and requires an apparatus to maintain the position of flexion, against which the extensors are to act in every step. It is just in this variety that arthrodesis, *i.e.*, ankylosis and fixation, together with correction of the deformity, seems to have its field for application.

In cases where the deformity is principally in the ankle-joint, Lauenstein's or Rydygier's incision and the extirpation of a wedge, including for the most part the talus and to a less extent the tibia with correction and fixation, seems to be the most feasible method. Where the deformity exists, both in the medio-tarsal and ankle-joints, arthrodesis of the ankle-joint and cuneiform osteotomy at the medio-tarsal joint are indicated.

In very old cases with great loss of power in the muscles and shortened limbs a cuneiform osteotomy, including the head and neck of the astragalus and part of the calcaneus, so fashioned as to leave the foot in partial extension to accommodate for the shortened limb, gives very good results.

Cases which will not allow of correction at all must be subjected to amputation.

In conclusion, I wish to state that I do not believe in any routine operative treatment for club-foot. Each case is to be studied for itself with the idea of restoring the function and relieving the deformity.

In the first and second degrees, when the treatment is begun shortly after birth, traction, stretching, massage and proper fixation generally suffice. When these are found to be insufficient, tenotomy of the tendo Achillis, tibialis posticus, or Phelps's operation, with or without fasciotomy, to correct the resistance in the soft parts and to bring the foot into position or, if the foot be one of the paralytic variety, arthrodesis of the ankle-joint may be indicated.

In the third degree of deformity, which includes what are spoken of as complicated or inveterate (and resistant) cases, operative treatment is, I think, always indicated. The former class of cases includes that variety in which, though the varus is reducible, the equinus cannot be corrected owing to the prominent irregular mass of bone which fills what should be a normal depression in front of the fibula. Cases with such a pathological condition admit of but one plan of treatment,—*i.e.*, the removal of a portion or the whole of the astragalus.

In the congenital club-foot of this variety, a complete extirpation is recommended. In the acquired variety of paralytic origin a cuneiform osteotomy, including this prominent angle of the astragalus and adjoining surface of tibia, is indicated as it fulfils the indication to correct the deformity and to produce a syndesmosis between the astragalus and tibia.

The inveterate cases are those in which the tarsus is misshapen, supination and adduction are present to a marked degree. The patient walks upon the cuboid and os calcis, or on the dorsum of the foot with practically no movement in the ankle-joint. Where tarsectomy is alone performed in this variety, it must be perfectly evident that the deformity exists principally in the medio-tarsal joint, and that the movement of flexion in the ankle-joint is possible to a right ankle. If, however, this movement of flexion is not possible or is restricted by the astragalus, and the supination of the calcaneus is marked, the extirpation of the astragalus and the division of the calcaneo-fibular ligament is necessary in addition to the cuneiform osteotomy of the tarsus. There are many grades of deformity in this variety, so that one is compelled to vary the extent of these two methods constantly. As factors in the production of the equinus and varus, the astragalus and calcaneus are to be studied in every case, since permanent results after partial correction of the deformity are largely dependent upon them. Unless the equinus is completely removed and the supination in the calcaneus is corrected, every step made by the patient aids a return of his varus.

It is imperative, if we wish to obtain a permanent and good result, to relieve all deformity completely and at once. This ought to be accomplished before the weight of the body is allowed to act upon the foot. It should not be our aim to obtain beautiful cosmetic results, for they are easily obtained and generally require the use of apparatus and support to avoid recurrence.

The clearest evidence of an imperfect operation is the need of an apparatus and support after correction has been accomplished.

A perfect operation implies a six to ten weeks in plaster-of-Paris splints and an ordinary laced shoe with an elevated sole in particular cases. In the case of equino-valgus and in that of calcaneo-varus, which have been here reported, I can only say that the results were gratifying. They are comparatively rare forms and the operative procedures were based upon the experience of others more versed in this variety.

This record includes the cases operated upon at the Roosevelt Hospital from 1886–1893.